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Empirically Based Analysis: The DDoS Case

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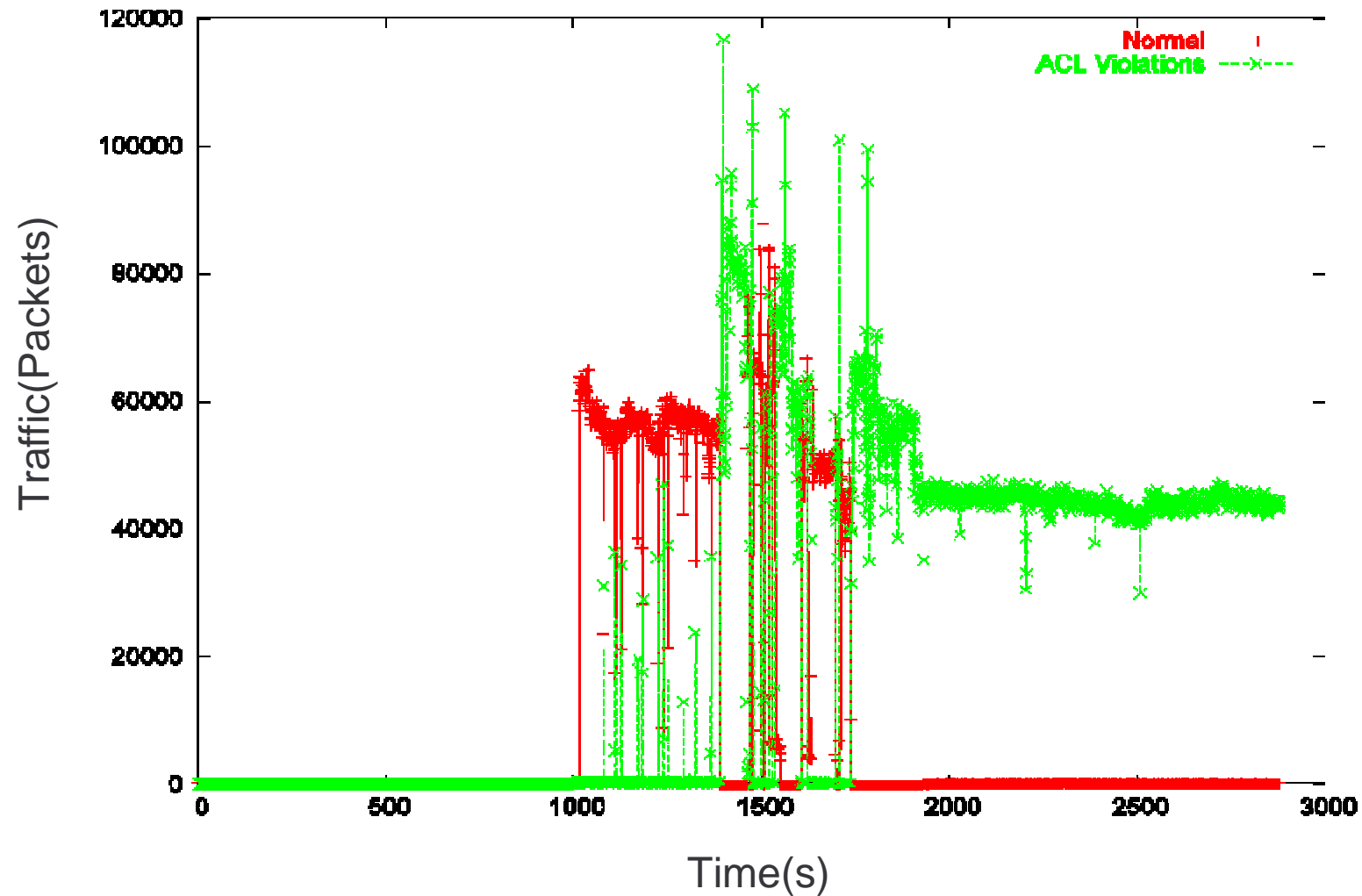


Introduction

- Ø Access to the dataset gives us a large enough record of traffic to test hypotheses in network security.
- Ø Given this, we select and evaluate various security measures against real traffic
 - Or a reasonable facsimile thereof
- Ø One example: target resident DDoS Filters
 - Heavily constrain the problem— not considering SYN floods, smurfing, reflection attacks...



Attacks like this





How Do We Test?

Ø Any analysis opens a can of worms...err,
“assumptions”

- The network constantly changes
- What is a representative host?

Ø Rerunning attacks is of debatable value

- Most of the legitimate traffic is dropped, that's what a DoS is *for*

Ø We want our results to be representative

- Test and summarize over multiple machines

Ø We want our results to be reproducible

- Depend heavily on SiLK structures and tools



Evaluation

Ø Trained filters on 15 days of legitimate traffic

- Built a representation of IP address: volume relationship (via `rwaddrcount`)

Ø Then generated a simulated DoS

- Botnet IPs collected with `rwset`
- Normal traffic selected from another day

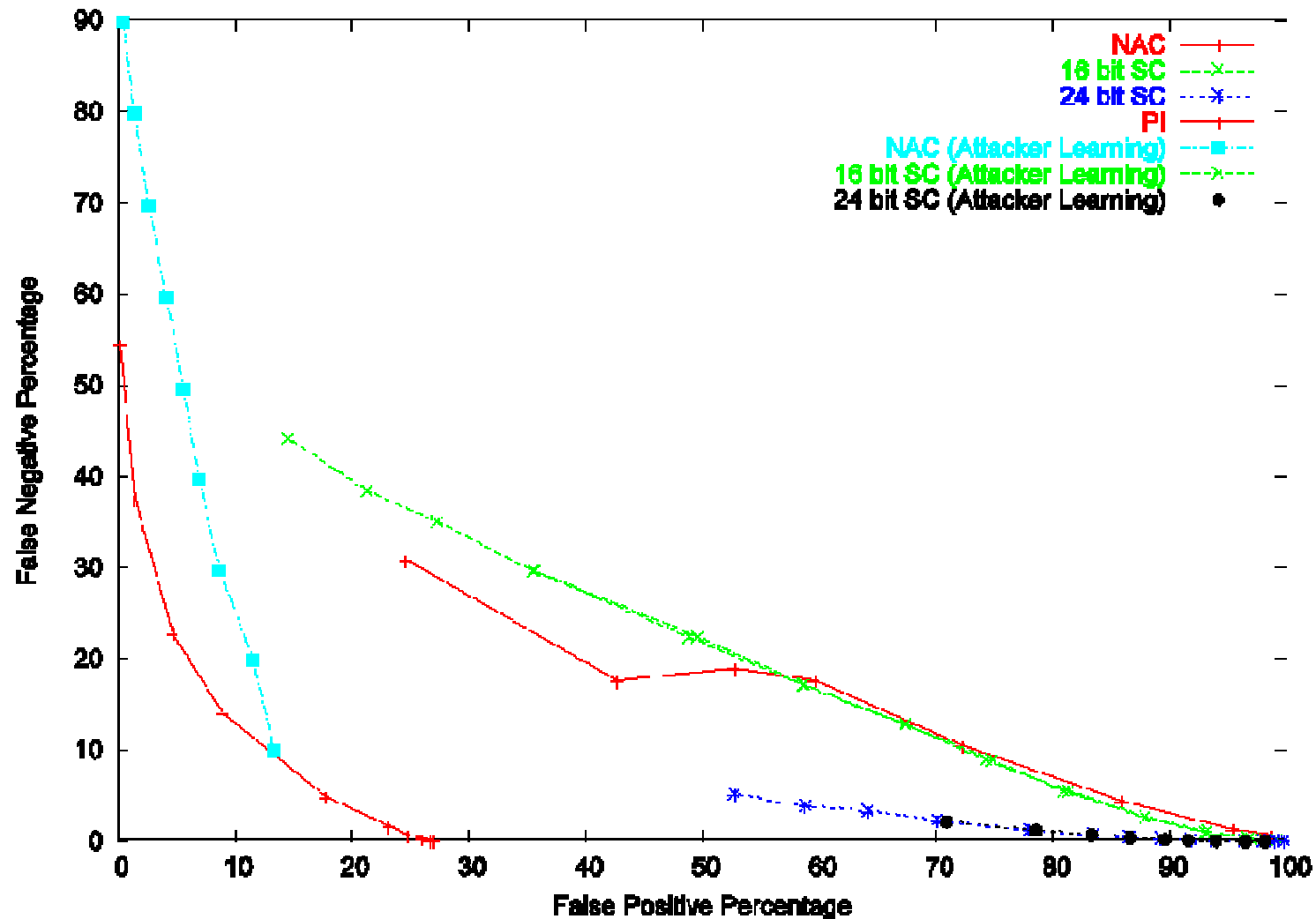
Ø Resulting traffic was then evaluated for failure rates

Ø Tested 2 types of filters:

- Clustering – groups of adjacent IP addresses
- PI – path marking approach



DoS Filters





Initial Observations

Ø Two groups

- One group assumes a magic DoS Detection Oracle
 - That's the group with better results

Ø In general, the filters don't do well

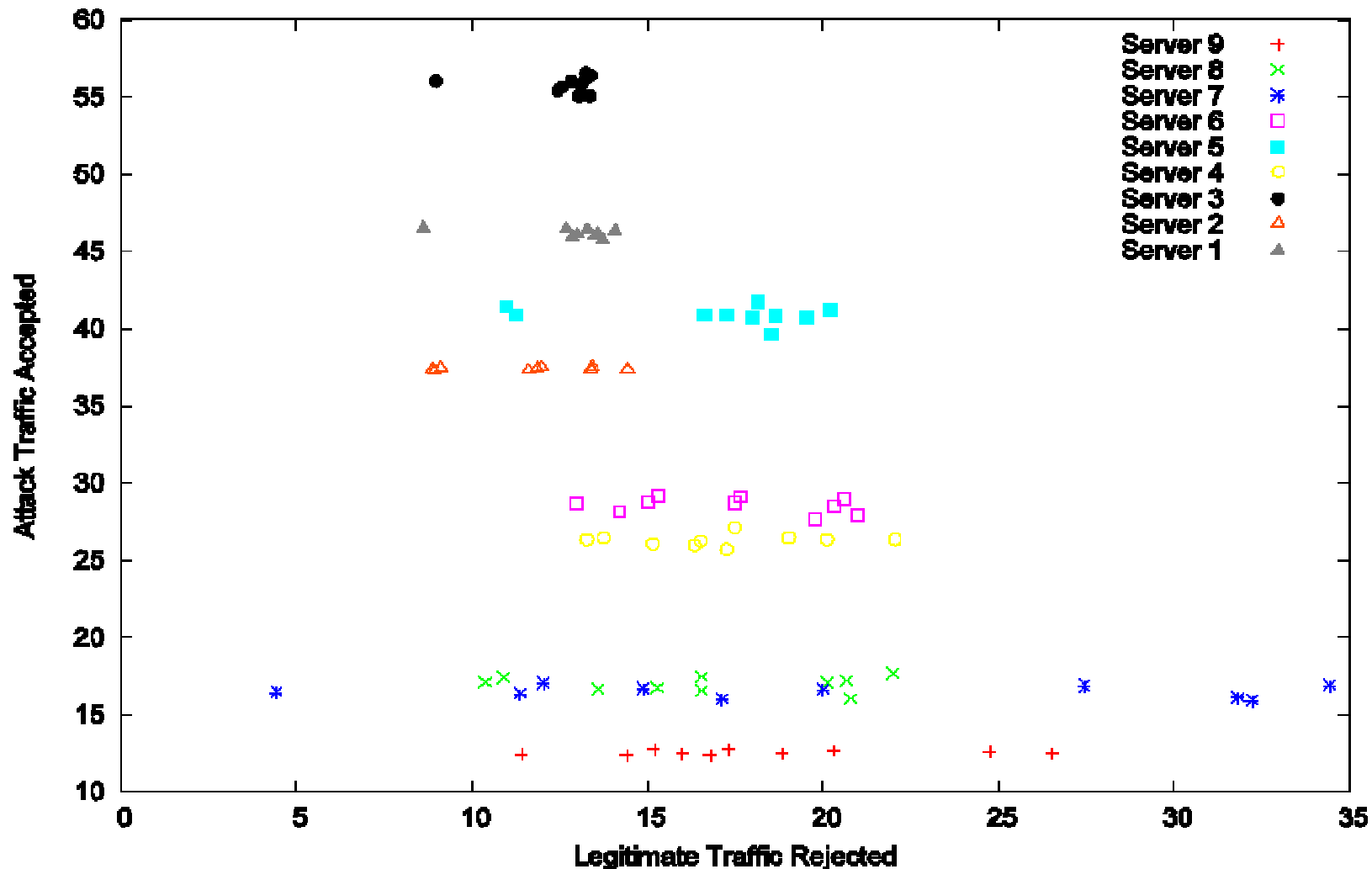
- Should we compare IP addresses, or packets?
- Is traffic different for different servers?

Ø Let's look at one result in more depth



One result in more depth

Comparative Failure Rates For 90% threshold, 25 Days Learning Time





Observations

Ø Normal traffic varies extensively

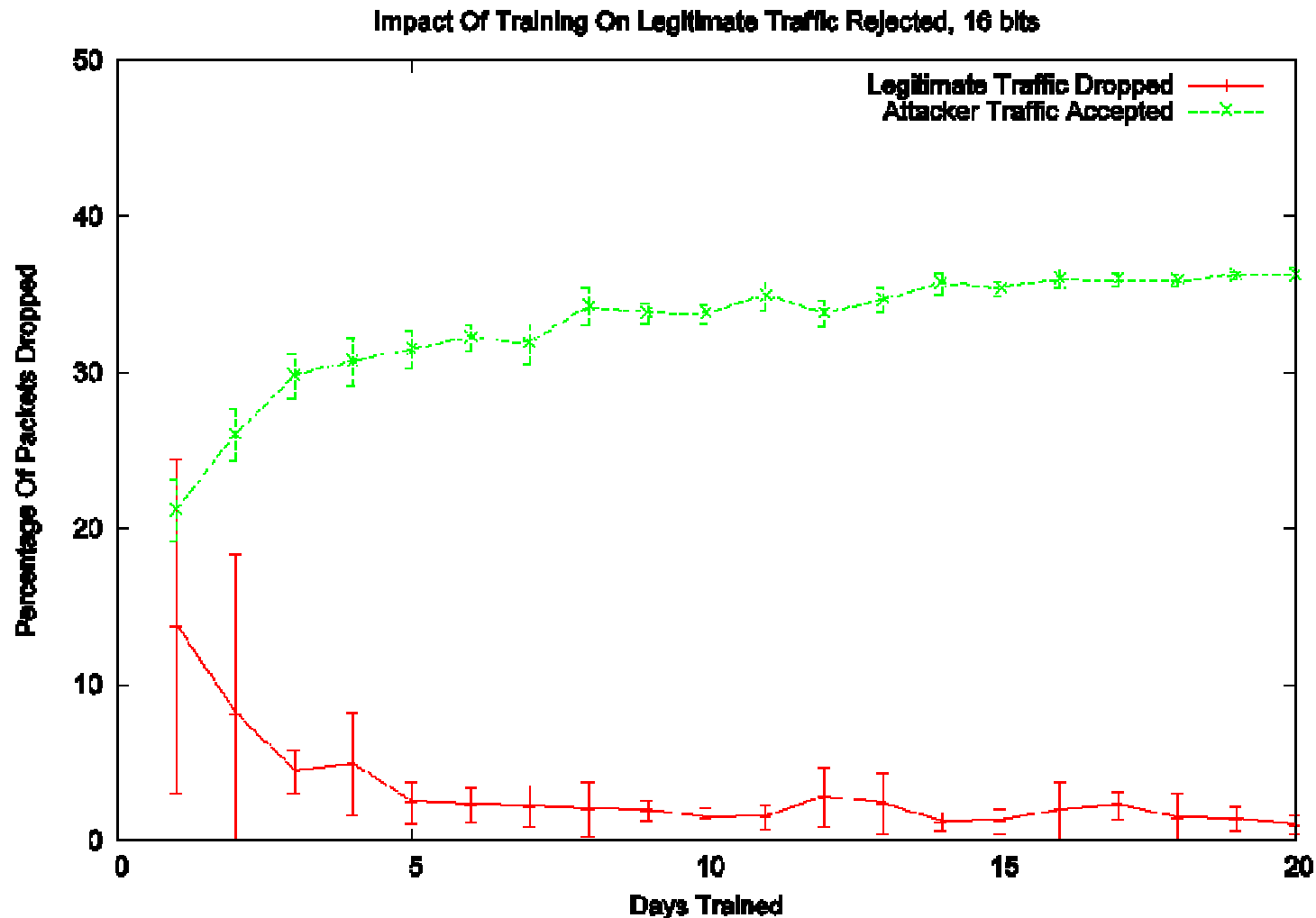
- Although it seems to vary more with “smaller” servers
- And it’s better when you look at packet counts
 - Which makes sense, given the absurd number of scanners we see.

Ø False negative rate (attackers accepted) seems to be related to server activity – the busier the higher.

- Attackers don’t vary as much



Learning Curves – 95% threshold





Other Observations

Ø In the majority of cases, packets are dropped because they've never been seen before

- Short learning curves – effectively no change in false positive rate after a week of learning.
- Especially true for spoofed traffic

Ø Entropy is lower than expected

- Filters that rely on spoof defense (HCF, PI) drop less than 10% of their packets because they detect a spoof



Further Work

Ø Exploiting our DoS attack traffic records further

- We know how the network reacts
- We know how the attack starts and ends
 - Which impacts learning curve for defenses that *only* profile the attack

Ø Further use of other network maps

- Skitter (used for PI), &c.

Ø Formalization of the techniques used

- Developed a matrix based approach for the final iteration
- Tools are going to be available publicly



A Final Note

ØURL for the SiLK tools:

<http://silktools.sourceforge.net>